The Impact of Logging on Amphibians

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Dr. Brodman holding an Eastern Hellbender, Tennessee, 2013.

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Red-back Salamander, Morgan-Monroe State Forest Ecoblitz Area, 2014. Source: Audrey Moore.

In pre-settlement times 85.4 to 87.5% of the acreage of Indiana was forested. In 2010 only 20.6% of the state was forested and most of that is on private property. Only 2.8% of Indiana is forested public land, and only a small portion of that is managed to protect wildlife. Most of our remaining forests are in south central Indiana with the highest amount in Brown County. This area provides the best habitat for amphibians in the state. Habitat loss is the biggest cause of the decline of amphibians and other wildlife; it is well known that amphibians decline dramatically when forests are clear-cut. The question then is whether an alternative timber management to clear-cutting can be used to maintain and protect amphibian populations while harvesting timber resources and further, whether substantive portions of our public forests, particularly the less developed areas of our state forests, should be spared from logging entirely to conserve amphibian populations which are declining dramatically on a world wide scale. The purpose of this essay is to review the peer-reviewed literature on the impacts of logging and timber management on amphibians.

Our best available knowledge on the topic is from 28 studies that have been published in peer-reviewed science journals. Ten of these studies investigate whether or not retaining riparian buffer zones during timber harvest would benefit amphibians. This method is a partial harvest that consists of leaving forested areas surrounding streams and ponds. The expectation is that this would provide refuge for amphibians during logging and also protect the water sources from run-off and sedimentation. Five of the studies looked at the use of shelterwood harvesting, which is partial cutting that removes trees uniformly over the plot, while leaving substantive portions of the canopy and allowing new seedlings of tree species preferred by foresters to grow. This method would also provide refuge for amphibians. These studies indicated that these methods are likely to be beneficial to amphibians compared to clear-cutting, but they also indicated that amphibians were better off in unharvested forest plots.

Seven studies examined the strategy to leave coarse woody debris in forests after a timber harvest. The idea is to maintain habitat on the forest floor despite the loss of trees. Another studied the uses of patch retention harvesting- where instead of clear-cutting, 10% of trees are retained in patches. These methods were shown to have mixed results, with trade-offs between benefits and harm to amphibians. They help migrating adults and dispersing juveniles move through the habitat, but also result in reduced fitness and diversity.

Seven studies investigated the use of leave-tree harvesting where instead of clear-cutting, a low density of high-quality trees are retained uniformly through the forest stand, or standing deadwood and snags are left in logged forests as shelter for amphibians. The results of these methods are not much different than clear-cutting and are more likely to cause more harm than benefit. These methods are unlikely to have any conservation value for amphibians.

Fourteen studies tested the effectiveness of tree thinning where up to 50% of trees are uniformly harvested or harvested as groups

of trees in patches instead of clear-cutting. The idea of these methods is to simulate disturbances that open up habitat and initiate natural succession. This large number of studies had some mixed results, indicating that they might be better than clear-cutting. However, most of the results indicate that these types of partial harvests are detrimental to amphibians compared to unharvested forest. The best conclusion is that they are likely to be just as harmful to amphibians as clear-cutting or less damaging than clearcutting but still harmful compared to leaving the forest unlogged.

This review into alternative forms of timber harvest shows that most of these are ineffective or harmful to conserving amphibian populations. Only two methods, retaining riparian zones and shelterwood cutting, have the potential to sustain amphibians in forests where trees are harvested, albeit at populations lower than in forests without harvesting. Other research suggests that wetlands and streams need 200-meter buffers of forests in order to protect water quality and to provide enough upland habitat for adult amphibian populations. A meta-analysis of 24 studies in North America found that shelterwood harvesting was the only partial harvest method that resulted in smaller reductions in salamander populations than clear-cutting; no method of logging matched unharvested forest controls. Given these results from peer-reviewed research, substantive portions of the Indiana state forests should be spared from timber harvesting altogether in order to maintain healthy populations of amphibians on the state's public lands. ♦

For a list of the extensive literature reviewed for this article, please visit www.indianaforestalliance.org.

Two-Lined Salamander, Morgan-Monroe State Forest Ecoblitz Area, 2014. Source: Audrey Moore.

Green Frog, Morgan-Monroe State Forest Ecoblitz Area, 2014. Source: Jeff Stant.

Long-Tailed Salamander, Morgan-Monroe State Forest Ecoblitz Area, 2014. Source: Jeff Stant.

Wood Frog, Morgan-Monroe State Forest Ecoblitz Area, 2014. Source: Bob Brodman.

Marbled Salamanders are one of many Indiana species that requires hardwood forests as habitat. Wesselman Woods, 2008. Source: Bob Brodman.